BRITISH STANDARD

BS 1501-3: 1990

Incorporating Amendment Nos. 1, 2, 3, 4, and 5

Steels for pressure purposes —

Part 3: Specification for corrosion-and heat-resisting steels: plates, sheet and strip

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Iron and Steel Standards Policy Committee (ISM/-) to Technical Committee ISM/73, upon which the following bodies were represented:

Associated Offices Technical Committee
BEAMA Ltd. (Power Generation Association)
British Compressed Air Society
British Gas plc
British Steel Industry
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
High Integrity Pipework Group, Power Plant Contractors' Association
Lloyd's Register of Shipping
Process Plant Association
Seamless Steel Tube Association
Water Tube Boiler Group, Power Plant Contractors' Association
Welding Institute

The following bodies were also represented in the drafting of the standard through subcommittees and panels:

British Industrial Fasteners Federation
Institute of Metals
National Association of Steel Stockholders

This British Standard, having been prepared under the direction of the Iron and Steel Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 28 February 1990

First published as BS 1501–1506 November 1950
First revision September 1958
Second revision as BS 1501-3, June 1973
Third revision February 1990

The following BSI references relate to the work on this standard:
Committee reference ISM/73
Draft for comment 87/40082 DC

ISBN 0 580 17828 5

Amendments issued since publication

Amd. No.	Date of issue	Comments
6744	July 1991	
6868	October 1991	
7026	June 1992	
8445	April 1995	
9647	September 1997	Indicated by a sideline in the margin

Contents

Foreword

This Part of BS 1501 has been prepared under the direction of the Iron and Steel Standards Policy Committee and supersedes BS 1501-3:1973, which is withdrawn.

The scope has been extended to include sheet and strip.

The main technical differences between this edition and the previous edition are that some steel types, included in the 1973 edition, have been deleted and that a number of new steel types have been incorporated in this edition. A comparison between the steel type numbers in the 1973 edition with their nearest equivalent numbers in this edition is given in Appendix A for information.

Changes have also been made to the chemical analyses and mechanical properties in alignment with international agreements, and maximum sulphur contents have been lowered to reflect current steel making practices. The format of this edition has also been changed to provide a basic specification together with a series of options in Appendix B which the purchaser may invoke when ordering. The opportunity has also been taken to metricate the specification.

The previous edition contained a number of clauses concerned with the inspection or witness of inspection by the purchaser or his agent. The clauses are not included in this edition as they are considered to be purely contractual arrangements. It is recommended that the purchaser discusses details and arrangements for the witness of sampling, testing and inspection with the manufacturer at the time of enquiry and order.

Estimated average stress rupture values are given in Appendix C and have been established from test data upon a large number of steel samples representative of commercial production. It is considered that these values may be reliably used for design purposes.

The appropriate British Standard for the design and construction of pressure vessels should be consulted for requirements relating to the application and permissible design stress for products made to this Part of BS 1501. This Part of BS 1501 is one of three Parts of BS 1501 specifying requirements for steel plates for pressure purposes. The other two Parts are as follows:

— *Part 1: Specification for carbon and carbon manganese steels: plates;*

— *Part 2: Specification for alloy steels: plates.*

Related standards are as follows:

BS 1502, *Specification for steels for fired and unfired pressure vessels: sections and bars.*

BS 1503, *Specification for steel forgings (including semi-finished forged products) for pressure purposes.*

BS 1506, *Specification for carbon, low alloy and stainless steel bars and billets for bolting material to be used in pressure retaining applications.*

This Part of BS 1501 has been amended to take into account the publication of the following European Standards:

EN 10029, *Hot rolled steel plates 3 mm thick or above — Tolerances on dimensions, shape and mass.*

EN 10048, *Hot rolled narrow steel strip — Tolerances on dimensions and shape.*

EN 10051, *Continuously hot-rolled uncoated plate, sheet and strip of non-alloy and alloy steels — Tolerances on dimensions and shape.*

EN 10258, *Cold-rolled stainless steel and narrow strip and cut lengths — Tolerances on dimensions and shape.*

EN 10259, *Cold-rolled stainless steel wide strip and plate/sheet — Tolerances on dimensions and shape.*

As further European Standards are produced this British Standard will eventually be withdrawn.

It has been assumed in the drafting of this Part of BS 1501 that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Request for elevated temperature property information. Elevated temperature values in this Part of BS 1501 represent the results of the most recent assessments. In keeping with the established practice for updating the mechanical properties, work continues on the collection and assessment of relevant data. Any resulting new values will be considered for future revisions of this Part of BS 1501 or equivalent standards.

Users of this Part of BS 1501 are invited to assist by sending relevant data to the Secretary of ISM/73/-/1, British Standards Institution, 3 York Street, Manchester M2 2AT (see Appendix D for pro forma).

Product certification. Users of this Part of BS 1501 are advised to consider the desirability of third party certification of product conformity with this Part of BS 1501 based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS 5750.

Enquiries as to the availability of third party certification schemes will be forwarded by BSI to the Association of Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 18, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

blank

Section 1. General requirements

1 Scope

This Part of BS 1501 specifies requirements for corrosion-and heat-resisting steel, in the form of plates 3 mm to 100 mm thick, wide strip and sheet 0.30 mm to less than 3 mm thick and narrow strip 0.050 mm to less than 3 mm thick, for pressure purposes, for use at ambient, elevated and low service temperatures.

Provision has been made for certain steels to meet properties at different combinations of temperature, and where appropriate, requirements are specified for ambient temperature properties only, and ambient temperature and elevated temperature properties.

With the exception of the duplex grade 318S13, the steels included in this Part of BS 1501 are not notch sensitive at ambient temperature nor at temperatures down to – 196 °C. Impact values are not specified, but see options **B.8** and **B.9**.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Designation

The steels shall be designated by the number of this British Standard, the steel type number and a suffix when appropriate.

For material supplied to specified ambient temperature properties only, no suffix shall be used.

The suffix "E" shall be used for material supplied and verified to specified elevated temperature properties in addition to specified ambient temperature properties (see **4.2**).

The suffix "LT" shall be used for material verified to low temperature impact requirements in addition to specified ambient temperature properties (see **4.2**).

Example. BS 1501-3, 316S51-E refers to steel type 316S51 with verified elevated temperature properties and ambient temperature properties.

NOTE A comparison between the designations for steels in the 1973 edition of BS 1501-3 and their nearest equivalents in this edition is given in Appendix A.

3 Material compliance

The steel products shall comply with the general requirements of this standard and with the specific requirements applicable to the grade concerned. Where any of the options given in Appendix B are called up at the time of the enquiry and order, the steel products shall comply with the requirements of any such options, in addition to the basic requirements.

4 Information to be supplied by the purchaser

4.1 General

The following information shall be supplied by the purchaser at the time of the enquiry and order:

a) the full material designation;

b) the product form (plate, coil or sheet), dimensions and quantity;

c) the details of any selected options and any special requirements that are additional to the basic requirements of this Part of BS 1501 (see **4.2**).

4.2 Options

If the purchaser does not indicate his wish to implement any of the options given in Appendix B and indicated below and does not specify his requirements at the time of the enquiry or order, the manufacturer or merchant shall supply in accordance with the basic requirements.

B.1 Steelmaking process

B.2 Supply condition

B.3 Cast analysis

B.4 Product analysis

B.5 Incidental elements

B.6 Special requirements

B.7 Elevated temperature tensile tests

B.8 Room temperature impact tests

B.9 Low temperature impact tests

B.10 Intergranular corrosion tests

B.11 Purchaser's or agent's witness of manufacturer's inspection and testing

B.12 Marking

B.13 Supply of plates with 0.3 mm under-thickness tolerance

5 Manufacture of the steel

The steel shall be made by an electric process and shall be fully killed.

NOTE 1 Unless a special electric steel making process has been agreed when ordering (see option **B.1**) the process is at the manufacturer's discretion.

NOTE 2 The further processing in the manufacture of the steel is at the manufacturer's discretion.

6 Supply condition

The material shall be supplied heat treated to the appropriate condition stated in Table 1 (see note 1). It shall be supplied free from scale unless ordered to finish number 0 in Table 2 and finally flattened when appropriate.

NOTE 1 For certain steel grades it is conditionally permissible for plates to be supplied hot rolled, without further heat treatment (see notes 2 and 3 to Table 1).
NOTE 2 Mill finishes are described in Table 2. When available and required by the order, plates may be supplied after the application of overall surface grinding or polishing processes (see option **B.2**).

Table 1 — Chemical composition (cast analysis), mechanical properties at ambient temperature and heat treatment

Steel type		Chemical composition													Mechanical properties					Heat treatment	Intergranular corrosion test
Steel number	Description	C		Si	Mn	P	S	Cr		Mo		Ni		Others	Proof stress value		Tensile strength		Elongation A (see note 1)	Solution anneal temperature (see notes 2, 3 and 4)	Treatment time at 650 °C to 700 °C (see note 5)
															$R_{p0.2}$	$R_{p1.0}$	R_m				
		min.	max.	max.	max.	max.	max.	min.	max.	min.	max.	min.	max.		min.	min.	min.	max.	min.		
		%	%	%	%	%	%	%	%	%	%	%	%	%	N/mm^2	N/mm^2	N/mm^2	N/mm^2	%	°C	min
304S11	CrNi 18/10 0.03C	—	0.030	1.00	2.00	0.045	0.025	17.00	19.00	—	—	9.00	12.00	—	180	215	480	680	40	1 000 to 1 100	30
304S31	CrNi 18/9 0.07C	—	0.07	1.00	2.00	0.045	0.025	17.00	19.00	—	—	8.00	11.00	—	195	230	500	700	40	1 000 to 1 100	— (see note 6)
304S51	CrNi 18/9 0.10C	0.04	0.10	1.00	2.00	0.045	0.025	17.00	19.00	—	—	8.00	11.00	—	195	230	490	690	40	1 050 to 1 120 (see note 7)	N/A (see note 8)
304S61	CrNi 18/9 0.03C/N	—	0.030	1.00	2.00	0.045	0.025	17.00	19.00	—	—	8.50	11.50	N:0.12 to 0.22	270	305	550	750	35	1 000 to 1 100	30
309S16	CrNi 25/14	—	0.08	1.00	2.00	0.045	0.025	22.00	25.00	—	—	13.00	16.00	—	205	240	510	710	40	1 000 to 1 100	— (see note 6)
310S16	CrNi 25/20	—	0.08	1.00	2.00	0.045	0.025	23.00	26.00	—	—	19.00	22.00	—	205	240	510	710	40	1 000 to 1 100	— (see note 6)
316S11	CrNiMo 17/12/2¼0.03C	—	0.030	1.00	2.00	0.045	0.025	16.50	18.50	2.00	2.50	11.00	14.00	—	190	225	490	690	40	1 020 to 1 120	30
316S13	CrNiMo 17/12/2¾0.03C	—	0.030	1.00	2.00	0.045	0.025	16.50	18.50	2.50	3.00	11.50	14.50	—	190	225	490	690	40	1 020 to 1 120	30
316S31	CrNiMo 17/11/2¼0.07C	—	0.07	1.00	2.00	0.045	0.025	16.50	18.50	2.00	2.50	10.50	13.50	—	205	240	510	710	40	1 020 to 1 120	15
316S33	CrNiMo 17/11/2¾0.07C	—	0.07	1.00	2.00	0.045	0.025	16.50	18.50	2.50	3.00	11.00	14.00	—	205	240	510	710	40	1 020 to 1 120	15
316S51	CrNiMo 17/11/2¼0.10C	0.04	0.10	1.00	2.00	0.045	0.025	16.50	18.50	2.00	2.50	10.00	13.00	—	205	240	510	710	40	1 050 to 1 120 (see note 7)	N/A (see note 8)
316S53	CrNiMo 17/11/2¾0.10C	0.04	0.10	1.00	2.00	0.045	0.025	16.50	18.50	2.50	3.00	10.50	13.50	—	205	240	510	710	40	1 050 to 1 120 (see note 7)	N/A (see note 8)
316S61	CrNiMo 17/11/2¼0.03C/N	—	0.030	1.00	2.00	0.045	0.025	16.50	18.50	2.00	2.50	10.50	13.50	N:0.12 to 0.22	280	315	580	780	35	1 020 to 1 120	30
316S63	CrNiMo 17/12/2¾0.03C/N	—	0.030	1.00	2.00	0.045	0.025	16.50	18.50	2.50	3.00	11.50	14.50	N:0.12 to 0.22	280	315	580	780	35	1 020 to 1 120	30
320S31	CrNiMo 17/12/2¼ Ti	—	0.08	1.00	2.00	0.045	0.025	16.50	18.50	2.00	2.50	11.00	14.00	Ti:5×C to 0.80 (see note 9)	210	245	510	710	35	1 020 to 1 120	30
321S31	CrNi 18/9 Ti	—	0.08	1.00	2.00	0.045	0.025	17.00	19.00	—	—	9.00	12.00	Ti:5×C to 0.80 (see note 9)	200	235	510	710	35	1 020 to 1 120	30
321S51	CrNi 18/9 0.10C Ti	0.04	0.10	1.00	2.00	0.045	0.025	17.00	19.00	—	—	9.00	12.00	Ti:5×C to 0.08 (see note 9)	175	210	490	690	35	1 020 to 1 120 (see note 7)	30
347S31	CrNi 18/9 Nb	—	0.08	1.00	2.00	0.045	0.025	17.00	19.00	—	—	9.00	12.00	Nb:10×C to 1.0 (see note 9)	205	240	510	710	30	1 020 to 1 120	30
347S51	CrNi 18/9 0.10C/Nb	0.04	0.10	1.00	2.00	0.045	0.025	17.00	19.00	—	—	9.00	12.00	Nb:10×C to 1.2 (see note 9)	205	240	510	710	30	1 050 to 1 120 (see note 7)	30
318S13	CrNiMo 22/5/3/N	—	0.030	1.00	2.00	0.025	0.020	21.00	23.00	2.50	3.50	4.50	6.50	N:0.08 to 0.20	480 (see note 10)	—	680 (see note 10)	880	25	1 020 to 1 100 (see note 7)	30
904S13	NiCrMoCu 25/20/5	—	0.030	1.00	2.00	0.040	0.025	19.00	22.00	4.00	5.00	24.00	27.00	Cu:1.00 to 2.00 (see note 11)	220	255	520	720	35	1 050 to 1 150 (see note 7)	30

NOTE 1 See **21.1.2**. In case of dispute, $5.65\sqrt{S_o}$ gauge length on round proportional test pieces or 50 mm gauge length on 12.5 mm wide rectangular specimens shall be used, where $\sqrt{S_o}$ is the original cross-sectional area of the test piece.

NOTE 2 The steel is cooled in water or rapidly in air.

NOTE 3 Hot rolled plates may be supplied in the "as rolled" condition cooled in water or rapidly in air, provided that the following conditions are met:

a) The temperature during hot-rolling does not fall below the minimum of the solution anneal temperature range;

b) the material is in a satisfactory metallurgical condition;

c) the mechanical property and intergranular corrosion requirements are satisfied.

NOTE 4 The terms "softening", "annealing" and "solution annealing" have the same meaning for these steels.

NOTE 5 When the intergranular corrosion test is required (see **B.10**), the intergranular corrosion test piece treatment temperature within this range shall be selected by the manufacturer unless otherwise agreed.

NOTE 6 For this steel the intergranular corrosion test is applicable (see **B.10**), but the intergranular corrosion test piece heat treatment is not applied.

NOTE 7 Note 3 is not applicable to this steel and plates are subject to the final solution annealing treatment.

NOTE 8 N/A = intergranular corrosion test not applicable except by special agreement.

NOTE 9 In this column, C is the carbon content of the cast.

NOTE 10 For plates > 20 mm thick $R_{p\,0.2\,min.}$ 450 N/mm^2, and for plates > 80 mm ⩽ 100 mm thick R_m 640/840 N/mm^2 apply.

NOTE 11 Nitrogen up to 0.15 % max. may be added by agreement.

Table 2 — Mill finishes

Finish number	Description	Comments
0	Hot rolled and softened but not descaled	Suitable only for certain heat-resisting applications, as the presence of oxide scale impairs resistance to corrosion. Surface inspection is not practicable
1	Hot rolled, softened and descaled	Generally used when smoothness and uniformity of finish are not important
2D	Cold rolled, softened and descaled	A uniform matt finish
2B	Cold rolled, softened, descaled and lightly rolled on polished rolls	A smooth finish for general applications. Brighter than finish number 2D
2A	Bright annealed (BA)	A cold rolled reflective finish retained through annealing
NOTE The sizes up to which mill finishes 2D, 2B and 2A are available will be different for different manufacturers.		

7 Chemical composition

7.1 Cast analysis

The chemical composition of the steel shall be determined by cast analysis and shall be within the range given in Table 1 for the selected steel grade.

NOTE See option **B.3**.

7.2 Product analysis

Analysis of the product may deviate from the specified cast composition range due to analytical reproducibility and heterogeneity arising during solidification. The permissible deviations from the specified cast composition range shall be as given in Table 3. The deviations given in Table 3 shall apply either above the specified maximum or below the specified minimum individual element limits, but not both above and below for the same element from different sample product analyses from the same cast.

NOTE See option **B.4**.

7.3 Incidental elements

Elements not specified in Table 1 shall not be intentionally added to the steel except for the purposes of deoxidation and inclusion modification. In the latter case the content of the element(s) added shall be reported.

NOTE 1 See option **B.5**.
NOTE 2 At the option of the steel maker boron may be added up to a maximum of 0.005 % to aid hot workability.

8 Freedom from defects

8.1 Surface condition

The surface condition of the plates shall comply with BS EN 10163-2, class B, Sub-class **2**.

NOTE 1 See option **B.6** and note 2 to **14.3.2**.
NOTE 2 Surface imperfections on sheets and strip may only be removed by agreement between the supplier and the purchaser.
NOTE 3 When coil is supplied, the degree or amount of surface imperfections may be expected to be more than for steel in cut lengths due to the impracticality of cutting it to remove them.

8.2 Internal soundness

In the absence of any special requirements material shall be deemed to be not worse than the internal soundness of grade LC1 of BS 5996.

NOTE See option **B.6**.

9 Dimensions and tolerances

The dimensions and tolerances of the material shall comply with the appropriate requirements given in section 2.

Table 3 — Permissible variations of product analysis from the specified composition range

Element	Maximum of the specified composition range	Permissible product analysis deviation from the specified composition
	%	%
C	⩽ 0.030 > 0.030	0.005 0.01
Si	⩽ 1.0	0.05
Mn	⩽ 2.0	0.04
P	⩽ 0.045	0.004
S	⩽ 0.025	0.003
Cr	> 15.0 ⩽ 20.0 > 20.0	0.20 0.25
Mo	> 2.0 ⩽ 3.0 > 3.0 ⩽ 5.0	0.08 0.10
Ni	> 5.0 ⩽ 10.0 > 10.0 ⩽ 20.0 > 20.0	0.10 0.15 0.20
Cu	⩽ 2.0	0.07
Nb	All ranges	0.05
Ti	All ranges	0.05
N	⩽ 0.22	0.01

10 Mechanical properties and intergranular corrosion tests

10.1 Prescribed tests

Room temperature tensile tests shall be carried out in accordance with section 3. The test results shall be within the appropriate limits given in Table 1.

10.2 Optional tests

When required by the order (see **4.2**) tensile tests at elevated temperature, impact tests and intergranular corrosion tests shall be carried out in accordance with the order and shall comply with section 3.

11 Test certificate

11.1 Manufacturer's supply

The manufacturer shall supply a certificate stating the following:

a) the number and date of this British Standard, i.e BS 1501-3:1990;

b) the full material designation (see clause **2**);

c) the identity reference by which the material can be related to the manufacturer's certificate (see clause **12**);

d) the cast number and cast analysis in respect of all specified elements, including specific incidental elements if required;

e) the results of product analysis if required;

f) the results of all the tests required by the specification and order including those for any special tests, and the test temperature for any elevated or low temperature tests;

g) the solution treatment temperature range, unless supplied as rolled (see note 3 to Table 1), and the supply condition.

The test certificate shall be issued by an authorized representative of the manufacturer.

11.2 Merchant's supply

If any steel is supplied from a merchant's stock, the merchant shall satisfy the purchaser by means of numbers or identification marks on the steel, or tag if parcels of steel are bundled, combined with the manufacturer's test certificate, that such steel has been tested and complies with this Part of BS 1501. If the merchant has altered the condition or dimensions of the steel, it is his responsibility to ensure that the material supplied still complies with this Part of BS 1501.

12 Marking

12.1 Each piece of steel as delivered shall be legibly marked near to one end and transverse to the principal rolling direction with the following:

a) the manufacturer's name, trade mark or logo;

b) the material designation;

c) the cast number;

d) an identity reference by which the plate can be related to the test results on the manufacturer's certificate;

e) the mark of a specially authorized inspector, when so required (see option **B.11**).

NOTE For items that are wrapped, bundled or boxed and for items with ground or polished surfaces, the details given in this subclause may be marked on the packaging or on a tag securely attached to it, provided that it is ensured that each individual piece of steel and the relevant test results can be related.

12.2 The marking method shall be at the option of the manufacturer and its quality shall be such that the marking is durable for at least one year in unheated storage under cover (see option **B.12**).

One of the following methods shall be used:

a) indelible ink marking;

b) painting;

c) stamping;

d) vibroetching.

NOTE 1 Electrical and chemical etching methods may be used by agreement with the purchaser.

NOTE 2 When used, metal stamps for marking should be of such a form and their application should be such that the markings do not result in the formation of undesirable stress raising notches.

12.3 When paint or ink marking is used, the dried film shall contain not more than 0.025 % (*m*/*m*) of any of the following metals:

a) lead;

b) tin;

c) copper;

d) zinc.

NOTE For certain applications, limits may also be required on the levels of sulphur and halogens in the paint or marking ink. These limits should be agreed between the supplier and the purchaser.

Section 2. Tolerances on dimensions and shape

13 General

The material shall conform to the tolerances given in **14.1** for non-continuously hot rolled flat products (quarto plate), in **14.2** for hot rolled wide strip and derived products, in **14.3** hot rolled narrow strip (rolled width less than 600 mm), in **15.1** for cold rolled wide strip and derived products and in **15.2** for cold rolled narrow strip (rolled width less than 600 mm), unless otherwise agreed at the time of enquiry and order.

14 Hot rolled products

14.1 Non-continuously hot rolled flat products (quarto plate)

Tolerances shall conform to BS EN 10029. Thickness tolerance class B shall apply, unless specifically agreed otherwise at the time of enquiry and order.

14.2 Hot rolled wide strip in coils, or sheet/plate cut from coils, or coils slit from wide strip

Tolerances shall conform to BS EN 10051

14.3 Hot rolled narrow strip

Tolerances shall conform to BS EN 10048

15 Cold rolled products

15.1 Cold rolled sheet/plate, cold rolled coil and slit coil (rolled width 600 mm or above)

Tolerances shall conform to BS EN 10259

15.2 Cold rolled narrow strip (rolled width less than 600 mm), cut lengths and strip slit from narrow strip

Tolerances shall conform to BS EN 10258

16 *Clause deleted*

Section 3. Sampling and testing

17 Testing

The tests required as indicated by the designation or otherwise specified (see clause **4**) shall be carried out according to the requirements of this section. Room temperature tensile tests shall always be carried out and the values shall be as given in Table 1 for the selected steel grade.

18 Number, position and identification of test samples

18.1.1 Plates from the same cast and of the same nominal thickness, treated together as a single furnace batch or consecutively in a continuous furnace using the same heat treatment conditions shall be selected for testing as follows, applying whichever criterion leads to the greater test frequency:

a) one plate in every 20 or part thereof;

b) one plate in every 5 000 kg or part thereof.

The plates selected for test shall be as widely distributed as possible within the heat treatment batch or treatment sequence.

Each strip heat treated continuously or in coil form shall be sampled.

18.1.2 Plates for testing shall be sampled as follows:

a) $\leqslant$ 3 000 kg individual plate mass and $\leqslant$ 15 m length at heat treatment: one end;

b) > 3 000 kg individual plate mass or > 15 m length at heat treatment: both ends.

Strip heat treated continuously or in coil form shall be sampled at both ends. Test samples from plates and strip shall be taken from excess material at the ends, midway between the centre and one edge and shall provide all of the required test pieces.

NOTE For plate or strip that has been satisfactorily heat treated and tested at the required frequency, the original test results shall apply for smaller pieces subsequently cut from it and supplied without any further processing.

18.1.3 Test samples and any test pieces subsequently cut from them shall be appropriately marked to maintain their identity and relationship to the parent material.

NOTE For elevated temperature tensile tests see option **B.7**.

19 Heat treatment of test samples

Test samples shall be taken after the final heat treatment of the material. They shall not be given any further heat treatment after the separation from the material they represent except when plate is already cut to size and reheat treatment is to be applied in accordance with **22.3**, in which case the test samples may be reheat treated together with the plate.

20 Preparation of test pieces

20.1 General

All test pieces shall be cut with their longitudinal axes transverse to the principal direction of rolling unless otherwise stated.

NOTE 1 In the case of certain narrow strip where only longitudinal testing is possible due to small width, longitudinal testing is permissible.

NOTE 2 For elevated temperature tensile test pieces see option **B.7**.

20.2 Room temperature tensile test pieces

For the room temperature tensile test one tensile test piece in accordance with BS EN 10002-1 shall be prepared from each test sample selected in accordance with clauses **17** and **18** and with its axis transverse to the direction of rolling. For plates up to 10 mm thick a rectangular test piece of full plate thickness shall be used. For plates exceeding 10 mm thick the test piece shall be as follows:

a) full thickness; or

b) the thickness reduced to 10 mm by planing or milling one face only; or

c) proportional and round in accordance with BS EN 10002-1.

20.3 Impact test pieces

When impact tests are required, three Charpy V-notch impact test pieces from each test sample shall be prepared in accordance with BS EN 10045-1 and shall be cut transverse to the direction of final rolling. The notch shall be cut perpendicular to the original surface of the plate (see Figure 3 and options **B.8** and **B.9**).

20.4 Intergranular corrosion test pieces

When intergranular corrosion tests are required, intergranular corrosion test pieces shall be prepared in accordance with BS 5903 and shall when applicable be heat treated at a temperature within the range 650 °C to 700 °C for the time specified in Table 1 followed by rapid cooling in air (see option **B.10**).

21 Test methods

21.1 Tensile test at room temperature

21.1.1 Tensile tests at room temperature shall be carried out in accordance with the appropriate procedures in BS EN 10002-1.

The tensile strength R_m, the proof stress values $R_{p0.2}$ and $R_{p1.0}$ and the elongation A shall be determined.

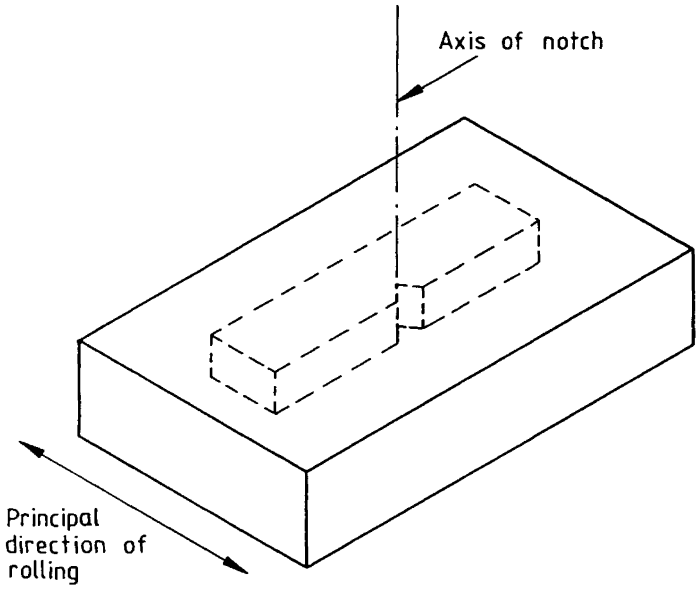

Figure 3 — Impact test piece

21.1.2 The elongation values in Table 1 relate to values obtained on 5.65 $\sqrt{S_o}$ on proportional test pieces, where S_o is the original cross-sectional area of the test piece, or on 50 mm gauge length × 12.5 mm wide rectangular test pieces in accordance with BS EN 10002-1. If other gauge lengths are used, the corresponding elongation shall be obtained as described in BS 3894-2.

NOTE For tensile tests at elevated temperature see option **B.7**.

21.2 Impact tests

When Charpy V-notch impact tests are required, the tests shall be carried out in accordance with BS EN 10045-1.

21.3 Intergranular corrosion test

When the intergranular corrosion test is required, it shall be carried out in accordance with BS 5903.

22 Retests

22.1 Room temperature and elevated temperature tensile tests

If any room temperature or elevated temperature tensile test fails to comply with the test requirement, two further tests shall be made on test pieces from the test sample from the plate represented. Provided the results of both of these further tests comply with the test requirements, all of the material represented shall be deemed to comply with this Part of BS 1501.

22.2 Impact tests

If the average of three impact tests fails to comply with the specified minimum average value, or one of the test pieces has a value less than 70 % of the specified minimum average value, three additional test pieces from the same test sample shall be tested and the results added to those previously obtained and a new average value calculated.

The new average value shall comply with the specified minimum average value. Not more than two of the individual values shall be lower than the specified average value and not more than one shall be lower than 70 % of this value.

22.3 Reheat treatment

The manufacturer shall be permitted to heat treat or reheat treat any material, including any material found not to comply with the test requirements, and then resubmit it for full testing.

Appendix A Steel numbers comparison

Table 12 lists the designations of steels to the 1973 edition of this Part of BS 1501 and compares them with the nearest equivalent steels in this edition. The nearest equivalent steels are not necessarily identical and the user should consult the relevant standards for detailed comparison.

Appendix B Options

NOTE See **4.2**.

B.1 Steelmaking process

The purchaser shall specify the electric steelmaking process that is to be used if any alternative processes are available from the manufacturer (see clause **5**).

B.2 Supply condition

The plates shall be supplied with overall ground or polished surfaces (see clause **6**).

B.3 Cast analysis

Details of elements in addition to those specified in Table 1 shall be supplied. The purchaser shall indicate which elements are required (see **7.1**).

B.4 Product analysis

Product analysis shall be determined by the manufacturer on one test sample used for the verification of the mechanical properties. The purchaser shall indicate whether the analysis is to be determined for each cast or for each plate or coil (see **7.2**).

B.5 Incidental elements

The purchaser by agreement with the manufacturer may specify a maximum content for one or more incidental elements. The actual content of the elements shall then be determined and reported in the manufacturer's certificate (see **7.3**).

B.6 Special requirements

Any special requirements for levels of surface or internal defects shall be agreed between the purchaser and the manufacturer, referring to the appropriate British Standards where available (see clause **8**).

Table 12 — Comparisons between the steel numbers in the 1973 edition of this Part of BS 1501 and their nearest equivalents in this edition

This edition (see note 1)		**1973 edition**	
304S11		304S12	
304S31		304S15	
304S51		304S49	
304S61		304S62	
—		304S65	(see note 2)
309S16	(see note 3)	—	
310S16		310S24	
316S11	(see note 4)	316S12	
316S13		—	
316S31		316S16	
316S33		—	
—		316S37	(see note 5)
316S51	(see note 4)	316S49	
316S53		—	
316S61		316S62	
316S63		—	
—		316S66	(see note 2)
—		316S82	(see note 5)
320S31		320S17	
—		—	
321S31		321S12	
321S51		321S49	
—		321S87	(see note 5)
347S31		347S17	
347S51		347S49	
—		347S67	(see note 5)
—		403S17	
—		405S17	
—		460S52	
—		NA14	(see note 6)
—		NA16	
318S13	(see note 3)	—	
904S13		—	

NOTE 1 Except for the new steels 318S13 and 904S13, the new steel numbers generally arise from small compositional changes from the former steel. The mechanical property limits are also changed.

NOTE 2 The nitrogen bearing steels are now limited to low carbon grades. The former mechanical property values for the low carbon grades were the same as for their normal carbon content nitrogen bearing counterpart.

NOTE 3 Newly introduced.

NOTE 4 Two new steel numbers, one Mo 2.00/2.50 % and the second 2.50/3.00 % replace the former steel grade with 2.25/3.00 % Mo or 2.00/2.75 % Mo.

NOTE 5 Removed due to lack of demand.

NOTE 6 Now classified as a nickel alloy.

B.7 Elevated temperature tensile tests

(designation suffix E)

One test sample shall be taken from each 30 t or part thereof from the same cast. The test samples shall be taken from a position adjacent to the room temperature tensile test sample.

Elevated temperature tensile testing shall be carried out in accordance with the appropriate procedures in BS 3688-1. Tests shall be carried out at the temperature stated by the purchaser, for which minimum proof stress values are given in Table 13 and Table 14. The $R_{p1.0}$ minimum values of Table 14 shall apply unless the purchaser states in the order that the minimum $R_{p0.2}$ values of Table 13 are to apply. The purchaser may indicate that $R_{p0.2}$ and $R_{p1.0}$ values are to be reported and may additionally require the R_m value to be reported.

B.8 Room temperature impact tests

Charpy V-notch impact tests at ambient temperature shall be done in accordance with the appropriate requirements of section 3. The minimum average value to be achieved shall be 55 J unless different minimum values are agreed for the order.

B.9 Low temperature impact tests

(designation suffix LT)

Charpy V-notch impact tests at low temperature shall be done in accordance with the appropriate requirements of section 3. The minimum values to be achieved shall be agreed between the manufacturer and the purchaser.

B.10 Intergranular corrosion tests

The intergranular corrosion test shall be done in accordance with the appropriate requirements of section 3. The test shall be carried out on one test sample per cast unless the purchaser states requirements for more frequent testing (see notes 5 and 6 to Table 1).

B.11 Purchaser's or agent's witness of manufacturer's inspection and testing

The purchaser shall provide details of the required witness of inspection and testing [see **12.1** e)].

B.12 Marking

Metal stamps shall not be used (see **12.2**).

B.13 Supply of plates with 0.3 mm under-thickness tolerance

Plates shall be supplied with thickness tolerances complying with class B of BS EN 10029.

Table 13 — Minimum proof stress ($R_{p0.2}$) at elevated temperatures

Steel number	$R_{p0.2}$ min. (in N/mm^2)	$R_{p0.2}$ min. (in N/mm^2) (see note 1)												
	20 °C	100 °C	150 °C	200 °C	250 °C	300 °C	350 °C	400 °C	450 °C	500 °C	550 °C	600 °C	650 °C	700 °C
304S11	180	121	108	98	90	82	76	74	71	70	68	67	—	—
304S31	195	132	120	109	100	93	87	84	81	79	78	76	—	—
304S51	195	132	120	109	100	93	87	84	81	79	78	76	—	—
304S61 (see note 2)	270	196	169	155	143	135	129	123	119	115	113	110	108	106
309S16 (see note 2)	205	140	128	116	108	100	94	91	86	85	84	82	—	—
310S16 (see note 2)	205	140	128	116	108	100	94	91	86	85	84	82	—	—
316S11	190	142	130	120	109	101	96	90	87	84	81	79	78	77
316S13	190	142	130	120	109	101	96	90	87	84	81	79	78	77
316S31	205	155	144	132	121	113	107	101	98	95	92	90	89	88
316S33	205	155	144	132	121	113	107	101	98	95	92	90	89	88
316S51	205	155	144	132	121	113	107	101	98	95	92	90	89	88
316S53	205	155	144	132	121	113	107	101	98	95	92	90	89	88
316S61	280	204	178	164	154	146	140	136	132	129	126	124	122	118
316S63	280	204	178	164	154	146	140	136	132	129	126	124	122	118
320S31 (see note 3)	210	165	150	137	128	122	117	112	109	105	102	100	97	96
321S31	200	154	149	144	139	135	129	124	119	116	111	108	105	102
321S51	175	128	123	117	114	110	105	100	95	93	90	88	86	84
347S31	205	171	162	153	147	139	133	129	126	124	122	121	—	—
347S51	205	171	162	153	147	139	133	129	126	124	122	121	—	—
318S13 (see note 4)	480	360	335	310	295	285	—	—	—	—	—	—	—	—
904S13 (see note 5)	220	175	165	155	145	135	130	125	120	110	105	—	—	—

NOTE 1 For the steel types for which sufficient data were available, the proof stress values given were derived from data collected and assessed in accordance with BS 3920, using the smoothed lower 95 % confidence lines. For certain other steel types insufficient data were available and other bases were adopted.

NOTE 2 Values based on 304 smoothed lower 95 % confidence lines.

NOTE 3 Values based on 316 smoothed lower 95 % confidence lines.

NOTE 4 Values based on the Stahl-Eisen Werkstoffblatt 400:1986 (Germany).

NOTE 5 Values based on ISO 9328:5 agreements (in preparation).

Table 14 — Minimum proof stress ($R_{p1.0}$) at elevated temperatures

Steel number	$R_{p1.0}$ min. (in N/mm^2)	$R_{p1.0}$ min. (in N/mm^2) (see note 1)												
	20 °C	100 °C	150 °C	200 °C	250 °C	300 °C	350 °C	400 °C	450 °C	500 °C	550 °C	600 °C	650 °C	700 °C
304S11	215	168	150	137	128	122	116	110	108	106	102	100	96	93
304S31	230	178	160	147	139	132	125	120	117	115	112	109	104	99
304S51	230	178	160	147	139	132	125	120	117	115	112	109	104	99
304S61 (see note 2)	305	230	201	182	172	163	156	149	144	140	136	131	128	124
309S16 (see note 2)	240	185	167	154	146	139	132	126	123	121	118	114	109	103
310S16 (see note 2)	240	185	167	154	146	139	132	126	123	121	118	114	109	103
316S11	225	177	161	149	139	133	127	123	119	115	112	110	107	105
316S13	225	177	161	149	139	133	127	123	119	115	112	110	107	105
316S31	240	189	172	159	150	143	137	133	129	125	121	119	116	113
316S33	240	189	172	159	150	143	137	133	129	125	121	119	116	113
316S51	240	189	172	159	150	143	137	133	129	125	121	119	116	113
316S53	240	189	172	159	150	143	137	133	129	125	121	119	116	113
316S61	315	238	208	192	180	172	166	161	157	152	149	144	142	138
316S63	315	238	208	192	180	172	166	161	157	152	149	144	142	138
320S31 (see note 3)	245	193	176	163	154	147	141	136	132	128	125	122	119	116
321S31	235	192	180	172	164	158	152	148	144	140	138	135	130	124
321S51	210	166	155	147	141	133	129	126	121	118	116	115	112	108
347S31	240	204	192	182	172	166	162	159	157	155	153	151	—	—
347S51	240	204	192	182	172	166	162	159	157	155	153	151	—	—
318S13 (see note 4)	530	410	385	360	345	335	—	—	—	—	—	—	—	—
904S13 (see note 5)	255	205	195	185	175	165	160	155	150	140	135	—	—	—

NOTE 1 For the steel types for which sufficient data were available, the proof stress values given were derived from data collected and assessed in accordance with BS 3920, using the smoothed lower 95 % confidence lines. For certain other steel types insufficient data were available and other bases were adopted.

NOTE 2 Values based on 304 smoothed lower 95 % confidence lines.

NOTE 3 Values based on 316 smoothed lower 95 % confidence lines.

NOTE 4 Values are tentative and may be revised when more data are available.

NOTE 5 Values based on ISO 9328-5 agreements (in preparation).

Appendix C Estimated average stress rupture values

The estimated average stress rupture values given in Table 15 have been established from data from tests upon a large number of samples of steel representative of commercial production. It is considered that these values may be reliably used for design purposes. Mean values are listed, but it is estimated that the scatter will not exceed ± 20 %.

Stresses corresponding to 1.0 % total strain are not given, but for 100 000 h to 200 000 h would be expected to be not less than two-thirds of the stresses corresponding to stress rupture under the same conditions of time and temperature.

Table 15 — Estimated average stress rupture values

Steel number	Rupture time	Estimated average stress for rupture (in N/mm^2)																						
		540 °C	550 °C	560 °C	570 °C	580 °C	590 °C	600 °C	610 °C	620 °C	630 °C	640 °C	650 °C	660 °C	670 °C	680 °C	690 °C	700 °C	710 °C	720 °C	730 °C	740 °C	750 °C	760 °C	770 °C
	h																								
304S51	10 000	—	186	174	163	153	144	134	126	117	109	102	94	87	81	74	68	63	56	53	49	45	42	39	37
	30 000	—	165	154	144	135	126	117	109	101	94	87	80	73	67	62	56	52	48	44	41	39	37	—	—
	50 000	—	155	145	136	126	118	110	102	94	87	80	73	67	62	56	52	48	44	41	39	36	—	—	—
	100 000	—	143	133	124	116	107	99	92	85	78	71	65	59	54	50*	46*	43*	40*	37*	—	—	—	—	—
	150 000	—	136*	127*	118*	109	101	94	86	79	72*	66*	60*	55*	51*	47*	43*	40*	38*	—	—	—	—	—	—
	200 000	—	131*	122*	113*	105*	97*	90*	82*	75*	69*	63*	57*	52*	48*	44*	41*	39*	36*	—	—	—	—	—	—
	250 000	—	127*	118*	110*	102*	94*	86*	79*	72*	66*	60*	55*	50*	46*	43*	40*	38*	—	—	—	—	—	—	—
347S51	10 000	258	236	218	202	187	174	162	151	140	131	121	113	104	96	88	80	71	61	—	—	—	—	—	—
	30 000	214*	197*	182*	169*	157	145	135	125	116	107	98	90	81	72	62	—	—	—	—	—	—	—	—	—
	50 000	196*	181*	167*	155*	144	133	123	114	105	96	87	78	69	56	—	—	—	—	—	—	—	—	—	—
	100 000	174*	161*	148*	137*	127*	117*	107*	98*	89*	80*	71*	58*	—	—	—	—	—	—	—	—	—	—	—	—
	150 000	162*	149*	138*	127*	117*	108*	98*	89*	80*	70*	57*	—	—	—	—	—	—	—	—	—	—	—	—	—
	200 000	154*	142*	131*	120*	110*	101*	92*	82*	72*	61*	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	250 000	147*	136*	125*	115*	105*	96*	86*	77*	66*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
321S51	10 000	222	206	192	178	165	152	140	129	118	108	98	88	79	71	63	56	49	43	38	—	—	—	—	—
	30 000	189	174	161	148	136	125	114	103	93	84	75	67	59	52	45	39	35	30	(27)	—	—	—	—	—
	50 000	174*	160*	147*	135*	124	112	102	92	82	73	65	57	50	44	38*	34*	29*	(26)*	—	—	—	—	—	—
	100 000	154*	142*	129*	118*	107*	96*	86*	77*	68*	60*	53*	46*	40*	35*	31*	(27)*	—	—	—	—	—	—	—	—
	150 000	143*	131*	119*	108*	97*	87*	78*	69*	61*	53*	46*	40*	35*	31*	(27)*	—	—	—	—	—	—	—	—	—
	200 000	136*	123*	112*	101*	91*	81*	72*	63*	55*	48*	42*	36*	32*	(28)*	—	—	—	—	—	—	—	—	—	—
	250 000	130*	118*	107*	96*	86*	76*	67*	59*	51*	45*	39*	34*	30*	(26)*	—	—	—	—	—	—	—	—	—	—
316S51	10 000	247	233	220	206	193	180	167	155	142	130	119	108	97	87	78	70	63	57	52	47	—	—	—	—
316S53	30 000	222	208	195	181	168	155	143	131	119	107	97	87	78	69	62	56	51	46	(42)	—	—	—	—	—
	50 000	210	197	183	170	157	144	132	120	108	97	87	78	70	62	56	51	46	(42)	—	—	—	—	—	—
	100 000	194*	181*	167*	154*	141	128	116	105	94	84	75	67	60	54	49*	(44)*	—	—	—	—	—	—	—	—
	150 000	185*	172*	158*	145*	132	120	108	97	86	77*	69*	61*	55*	50*	(45)*	—	—	—	—	—	—	—	—	—
	200 000	178*	164*	151*	138*	125	113	102	91	81	72*	65*	58*	52*	47*	(43)*	—	—	—	—	—	—	—	—	—
	250 000	173*	159*	146*	133*	120*	108*	97*	87*	77*	69*	61*	55*	50*	(45)*	—	—	—	—	—	—	—	—	—	—

NOTE Asterisks indicate where values have been obtained by "extended time" extrapolation and parentheses indicate where values have been obtained by "extended stress" extrapolation. Such values should be used with caution.

Table 15 — Estimated average stress rupture values

Steel number	Rupture time	Estimated average stress for rupture (in N/mm^2)																		
		500 °C	510 °C	520 °C	530 °C	540 °C	550 °C	560 °C	570 °C	580 °C	590 °C	660 °C	610 °C	620 °C	630 °C	640 °C	650 °C	670 °C	680 °C	690 °C
	h																			
304S61	10 000	308	288	270	254	239	225	212	199	188	177	167	157	147	138	129	120	—	—	—
	30 000	270*	252*	236*	221	207	195	182	171	160	150	140	130	120	110	(100)	—	—	—	—
	50 000	252*	236*	220*	206	193	180	169	158	147	137	127	117	106	(96)	—	—	—	—	—
	100 000	230*	214*	199*	186	173	161	150	139	129	118	107	(96)	—	—	—	—	—	—	—
	150 000	216*	201*	187*	174*	162*	150*	139*	128*	117*	106*	(94)*	—	—	—	—	—	—	—	—
	200 000	207*	192*	179*	166*	154*	142*	131*	120*	108*	—	—	—	—	—	—	—	—	—	—
	250 000	200*	185*	172*	159*	147*	136*	124*	113*	(101)*	—	—	—	—	—	—	—	—	—	—
316S61	10 000				349	329	311	294	278	262	247	233	218	204	189	175	159	142	122	—
316S63	30 000				325	306	289	272	256	241	226	211	196	180	164	146	127	—	—	—
	50 000				315*	297*	279*	263*	247*	231	216	200	185	169	151	132	—	—	—	—
	100 000				302*	284*	267*	250*	234*	218*	202*	186*	170*	152*	132	—	—	—	—	—
	150 000				295*	277*	259*	243*	227*	211*	194*	178*	160*	141*	(120)*	—	—	—	—	—
	200 000				289*	271*	254*	238*	221*	205*	189*	172*	154*	133*	—	—	—	—	—	—
	250 000				285*	268*	250*	234*	217*	201*	184*	167*	148*	127*	—	—	—	—	—	—

NOTE Asterisks indicate where values have been obtained by "extended time" extrapolation and parentheses indicate where values have been obtained by "extended stress" extrapolation. Such values should be used with caution.

Table 15 — Estimated average stress rupture values

Steel number	Rupture time	Estimated average stress for rupture (in N/mm^2)															
		600 °C	610 °C	620 °C	630 °C	640 °C	650 °C	660 °C	670 °C	680 °C	690 °C	700 °C	710 °C	720 °C	730 °C	740 °C	750 °C
	h																
310S16	10 000	137	120	105	92	81	72	64	57	51	47	42	39	35	32	30	28
	30 000	113	98	85	75	66	58	52	46	42	38	34	31	29	27	24.5	22.5
	50 000	104*	90*	78*	68*	60*	53*	47*	42*	38	35	32	29	26	24.5*	22.5*	21*
	100 000	92*	79*	69*	60*	53*	47*	42*	38*	34*	31*	28*	26*	23.5*	22*	20*	18.5*
	150 000	86*	74*	64*	56*	50*	44*	39*	35*	32*	29*	26*	24*	22*	20*	18.5*	17*
	200 000	82*	71*	61*	54*	47*	42*	38*	34*	31*	28*	25*	23*	21*	19.5*	18*	16.5*
	250 000	79*	68*	59*	52*	46*	41*	36*	33*	29*	27*	24*	22*	20*	18.5*	17*	16*

NOTE Asterisks indicate where values have been obtained by "extended time" extrapolation and parentheses indicate where values have been obtained by "extended stress" extrapolation. Such values should be used with caution.

Table 15 — Estimated average stress rupture values

Steel number	Rupture time	Estimated average stress for rupture (in N/mm^2)															
		760 °C	770 °C	780 °C	790 °C	800 °C	810 °C	820 °C	830 °C	840 °C	850 °C	860 °C	870 °C	880 °C	890 °C	900 °C	910 °C
	h																
310S16	10 000	26	24	22	21	19.5	18	17	16	15	14	13	12	11.5	10.5	10	9.5
	30 000	21	19.5	18	17	15.5	14.5	13.5	12.5	12	11	10	9.5	(9)	—	—	—
	50 000	19*	18*	16.5*	15.5*	14*	13*	12*	11.5*	10.5*	10*	(9)*	—	—	—	—	—
	100 000	17*	15.5*	14.5*	13.5*	12.5*	11.5*	10.5*	10*	(9)*	—	—	—	—	—	—	—
	150 000	16*	14.5*	13.5*	12.5*	11.5*	10.5*	10*	(9)*	—	—	—	—	—	—	—	—
	200 000	15*	14*	13*	12*	11*	10*	9.5*	—	—	—	—	—	—	—	—	—
	250 000	14.5*	13.5*	12.5*	11.5*	10.5*	9.5*	(9)*	—	—	—	—	—	—	—	—	—

NOTE Asterisks indicate where values have been obtained by "extended time" extrapolation and parentheses indicate where values have been obtained by "extended stress" extrapolation. Such values should be used with caution.

Appendix D Request for room and elevated temperature property information

D.1 General

For future revisions of this Part of BS 1501 and International Standards, room and elevated temperature information is invited from users of this Part of BS 1501, as detailed in **D.2** to **D.5**

Information should be sent to the Secretary of ISM/73/-/1, British Standards Institution, 3 York Street, Manchester M2 2AT.

It is emphasized that available information should be sent even if all details below are not completed.

D.2 Manufacturing details

Cast no.

Code no.

Steel maker

Testing laboratory

Steel making process (include any secondary refining and/or remelting processes used)

Deoxidation practice

Concast/ingot size

Concast/ingot mass

Product form

Product dimensions (outside diameter and thickness for tube)

Product process route

D.3 Chemical composition

State whether information provided is cast or product composition.

Detailed chemical composition data to include, where known, the following:

C, Si, Mn, P, S, Cr, Mo, Ni, Al, As, B, Bi, Co, Cu, N, Nb, Pb, Sb, Sn, Ti, V, W, Zr

D.4 Heat treatment of test sample or test piece

a) Pretreatments

b) Austenitizing treatment (solution treatment)

Actual temperature

Time at temperature

Cooling medium

Cooling rate and temperature range over which measured if control cooled

c) Any subsequent treatments [e.g. post weld heat treatment(s)]

Indicate if treatments are works or laboratory treatments

D.5 Test results

Laboratory accreditation

Test piece location/direction (e.g. transverse)

Test piece size

Strain rate used in tensile test(s)

Room and elevated temperature tensile properties [to include $R_{p0.2}$, $R_{p1.0}$ (state stress units), R_m, A and Z (i.e. percentage reduction of area) where determined]

Elevated temperature stress rupture/creep data (to include temperature stress, duration, A and Z) (please state whether test is completed or unbroken at duration stated) (time to specific creep strain(s), e.g. 0.05 %, 0.1 %, 0.2 %, 0.5 %, 1 %)

Testing atmosphere

blank

Publications referred to

BS 131, *Methods for notched bar tests.*

BS 1501, *Steels for pressure purposes.*

BS 1501-1, *Specification for carbon and carbon manganese steels: plates*[1)].

BS 1501-2, *Specification for alloy steels: plates*[1)].

BS 1502, *Specification for steels for fired and unfired pressure vessels: sections and bars*[1)].

BS 1503, *Specification for steel forgings (including semi-finished forged products) for pressure purposes*[1)].

BS 1504, *Specification for steel castings for pressure purposes*[1)].

BS 1506, *Specification for carbon, low alloy and stainless steel bars and billets for bolting material to be used in pressure retaining application*[1)].

BS 3688, *Methods for mechanical testing of metals at elevated temperatures.*

BS 3688-1, *Tensile testing. Metric units.*

BS 3894, *Method for converting elongation values for steel.*

BS 3894-2, *Method of conversion for application to austenitic steels.*

BS 3920, *Procedure for deriving and verifying the minimum elevated temperature yield or proof stress properties of steel products.*

BS 3920-1, *Method for deriving the minimum elevated temperature yield or proof stress properties when data on a minimum of 50 casts are available.*

BS 3920-2, *Method for deriving the elevated temperature yield or proof stress properties when data are limited.*

BS 5750, *Quality systems*[1)].

BS 5903, *Method for determination of resistance to intergranular corrosion of austenitic stainless steels: copper sulphate — sulphuric acid method (Monypenny Strauss test).*

BS 5996, *Methods for ultrasonic testing and specifying quality grades of ferritic steel plate.*

BS 6512, *Specification for limits and repair of surface discontinuities of hot-rolled steel plates and wide flats.*

BS EN 10002, *Tensile testing metallic materials.*

BS EN 10002-1, *Method of test at ambient temperature.*

BS EN 10029, *Hot rolled steel plates 3 mm thick or above — Tolerances on dimensions, shape and mass.*

BS EN 10045, *Charpy impact test on metallic materials.*

BS EN 10045-1, *Test method (V- and U-notches).*

BS EN 10048, *Hot-rolled narrow steel strip — Tolerances on dimensions and shape.*

BS EN 10051, *Continuously hot-rolled uncoated plate, sheet and strip of non-alloy and alloy steels — Tolerances on dimensions and shape.*

BS EN 10163, *Delivery requirements for surface conditions of hot rolled steel plates, wide flats and sections.*

BS EN 10163-2, *Plate and wide flats.*

BS EN 10258, *Cold-rolled stainless steel and narrow strip and cut lengths — Tolerances on dimensions and shape.*

BS EN 10259, *Cold-rolled stainless steel wide strip and plate/sheet — Tolerances on dimensions and shape.*

ISO 9328, *Steel plates and strips for pressure purposes.*

ISO 9328-5, *Austenitic steels.*

Stahl-Eisen Werkstoffblatt (SEW) 400 Stainless rolled and forged steels[2)].

[1)] Referred to in the foreword only.
[2)] in preparation.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL